Male Verses Female Brains

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Male verses Female Brains

Laurel Olfson

The idea of female versus male is one that, throughout history, has jumped between extremes. The differences were once thought to be null, as women were simply smaller, inferior men. In the mid 1800s, the idea of gonads and their hormones switched the thought over to women and men being entirely different, shaped by their respective reproductive structures. Later, significant differences in the male versus female brains of animals were noted, leading to the discovery of chromosomal nuclei in the brain – the next extreme. This paper will start with the notion given by religion, namely Christianity, and move through to today’s more overarching, multifactor approach.

Creationism, an idea given by the Christian Bible, says that God created man (read: males) in His image, and then women from the rib of man. It is from this start that the two sexes were considered to be the same, except women were smaller and weaker. Through observation of human brains, it became apparent that males have larger brains than females, solidifying this assumption. These measurements weren’t biased by the times, as this is still found in recent years. The greater size is found now to be due to men having more white matter in the cerebrum than women (Giedd et al., 1996 in [1]). Even today, it is still assumed that men can be used in studies as the general representation of humans. In other words, in many experiments, there are either significantly more men used or women simply aren’t used at all (Zucker, & Beery, 2010 in [2]). This despite the evidence we have accumulated over time that men and women are intrinsically different.

The next wave of male and female distinctions came about in 1849 when Arnold Berthold discovered that, upon removing the testes of roosters, they would be less aggressive, less interested in mating with hens, and have smaller than average combs and waddles. After seeing these behaviors and characteristics return with the reattachment of the testes, Berthold concluded that they, the gonads, must release something, now known to be hormones, into the blood which acts on the behavior and physical qualities of the organism [3]. The idea created here, then, is that typical male and female characteristics are thought to be caused purely by the respective gonads (Arnold & Gorski, 1984, and Breedlove, Cooke, & Jordan, 1999 in [4]). With this idea, distinguishing factors between gendered brains is due to hormone washing, both prenatally and through life [5]. Hormones are often still the main focus of studies because they are easier to work with [4]. Though it is unethical to study the effects of deliberately changing hormones in humans, animals such as rats are often used for this purpose. The correlation of cause and effect is very tangible with hormones and organism characteristics. In 1980 it was noted that by treating female finches with typical male finch hormones (Gurney & Konishi, 1980 in [6]), the females began to sing
courtng songs generally only done by males. However, no finch was every fully sex reversed (Arnold, 2002 in [6]). Hormones, then, could not be the final answer to brain sex.

Before being studied beyond the gonads and their hormones, the differences, besides overall size, between male and female brains in animals were noted. For example, male zebra finches have larger song nuclei than females and sing courting songs (Nottebohm & Arnold, 1995 in [6]). Studies of sex differences in the brain of song birds began (Nottebohm & Liu, 2010 in [2]), and soon differences in humans were being looked at as well. It was found that male and female humans process activities in their brains in different ways, like in the Morris Water Maze spatial learning test. The same 'product' of the test is reached through entirely different brain pathways (Beikio et al., 2004, and Perrot-Sinal, 1996 in [2]). A fundamental difference in individual neurons in the brain was discovered next: men and women brain neurons have their respective chromosomes of XY or XX [2]. Within each cell of a female brain, one X is expressed and one effectively ‘turned off,’ made into a Barr body. In the female brain, then, two neighboring neurons may be expressing different chromosomes. In males, both the X and Y chromosome must be expressed in each cell, meaning each neighboring neuron is expressing the same chromosomes [4]. An interesting brain exemplifying this is that of the Bilateral Gynandromorphic Zebra Finch, which is half genetically female, half genetically male. For instance if the left half of the brain is ZW (for birds and some other animals, ZW determines females and ZZ determines males), the left side of the gynandromorphic finch’s body appears female – the right side then is ZZ and appears male. What is interesting about this finch is the way it interacts with ‘normal’ zebra finches. The gynandromorphic finch sings courting songs to females, which occasionally leads to successful reproduction with the females. Successful, here, meaning that the female lays and sits on eggs that are, however, infertile. On the other hand, when put with males, the gynandromorphic finch is attacked, meaning it is seen as a legitimate threat to mating by a full male. Half female, the gynandromorphic finch is treated fully male. When examining its brain, Arnold (2004) saw that certain brain areas, like the song region called Area X, were larger than in control females but smaller than in control males [6]. Sex chromosomes, then, affect the development of a brain by affecting the gonads – male or female – and by determining the ‘sex’ of every neural nucleus [4].

This leaves us where we are today. We know that there is no one answer to how male versus female brains are determined, but instead that many factors work together to produce the end product of a sexed brain. The differences between male and female brains may not be drastic, but as the years go by we are only learning more.
References


